

VIII. *Observations of the effects of low Temperatures on Larvæ.* By ELEANOR A. ORMEROD, F.M.S.

[Read April 2nd, 1879.]

DURING the course of the recent severe winter, the unusually long duration of low temperature, with the occasional fall much below the average, suggested it would be a good opportunity for observing whether—(according to the popular idea that frost “kills the grubs”)—the larvæ exposed to the full rigour of cold were materially injured by it.

I was only able to procure specimens of a few kinds, but in every case, whether Coleopterous larvæ in the ground, under bark, or in unprotected galls; Lepidopterous larvæ or pupæ in wood, in the ground, or exposed to the air; several species of Cynipideous larvæ in galls; and a few insects in various stages on bark; and (passing on to the *Acari*), in the case of the bark mites, and also of the *Phytopti* of the filbert bud-galls, I scarcely ever found the slightest appearance of injury from the frost beyond temporary suspension of the powers of movement.

I had the opportunity of making the observations in connection with daily notes of the temperature, and should be glad if a few of the details, given as shortly as possible, are of sufficient interest for me to be allowed to offer them.

During December the minimum shade temperature at four feet from the ground varied, on eighteen successive nights, from as low as nine to no higher than twenty-nine degrees; during January, from ten degrees and a fraction to thirty degrees on twenty-five nights, and during this time the minimum on the grass read down (omitting fractions) on various occasions to nine, eleven, thirteen, sixteen and seventeen degrees,—twice to eighteen,—six times to twenty degrees, whilst the frost penetrated so deeply into the ground, that during several days in December, and from the 12th of January to the 6th of February, the earth thermometer showed a temperature

of only thirty-two degrees and a fraction, at one foot below the surface. In other words, the air temperature was much below freezing-point for a large proportion of the time, and the soil frost-bound for nearly a foot down, its condition being made worse for animal life by the occasionally melting snow soddening, and re-freezing on the surface.

In the case of the larvæ of the *Ceutorhynchus sulcicollis* (the cabbage and turnip gall weevil), I had a large number of cabbage plants brought in for examination on the 4th of February from a spot where they had been exposed to the full severity of the weather, with the galls either on the ground level or an inch or two beneath it. Of these I examined thirty-seven simple or compound galls containing one to four larvæ apiece, and found that with a single exception every larva was alive and healthy. On opening the galls the larvæ were usually lying quite torpid in the slightly-curved position natural to them in repose, and uncurled gradually, and regained power of movement under the action of warmth. Some recovered immediately, others in one or two minutes, and such as still remained motionless whilst in the cold gall, or on the blade of a knife, moved again when breathed upon or otherwise warmed. I also noticed that the larvæ in such of the galls as had been nearest the surface, or completely on the ground level, were generally the slowest to recover.

The seventy or eighty larvæ which I examined were of all sizes, from the minutest observable by the naked eye lying in the still-forming gall to full-, or nearly full-grown specimens, almost ready to leave the hollowed chambers in which they lay amongst the rubbish and rejected matter of their workings.

On thawing back into their normal physical condition their normal instincts appeared also in full play, for on being placed on soft earth they made their way (as usual on removal from their galls) into the soil, and I found (by subsequent examination) formed their oval earth-cases as in ordinary circumstances. I also found specimens of *Ceutorhynchus sulcicollis* larvæ on the 9th of February in turnip galls which had been fully exposed to the severity of the weather; these were in full health after the temporary thaw, in every gall that I opened.

In the case of Coleopterous larvæ in earth I found those of *Otiorhynchus sulcatus*, on the 26th of January, contained in earth in flower-pots (frozen so hard as to

require blows of a hammer to break it) lying perfectly stiff and motionless, the surface temperature at the spot having stood at various heights, from eighteen to twenty-eight degrees, on the ten previous nights. On examining again on February 7th after the thaw, I found the larvæ (with one exception) perfectly well, and recovering power of movement on being placed in moderate warmth.

Larvæ of *Scolytus destructor*, motionless in elm bark about two feet from the ground, on the 5th of February were also perfectly healthy in almost every case, and recovered power of movement on being brought into a warm room after lying for the night in a temperature of about forty-three degrees.

Of Lepidopterous larvæ I was only able to observe a very few specimens, but I found a caterpillar, apparently of the Cabbage Moth—*Mamestra Brassicæ*—(but from the ill-defined colouring, not distinguishable with certainty from that of *Triphæna Pronuba*), perfectly well and thriving when dug up during the frost, and again, on the 1st of March, at a depth of only two or three inches underground. Larvæ of *Zeuzera Æsculi* on the 7th of February, and a few days later were well and active in holly stems, of which one was only thick enough to allow good accommodation for the larva, and consequently could have given little protection from cold.

Of *Pieris* pupæ I had only just enough to show *Pieris Napi* torpid with cold when brought in, but recovering power of contortion next day and continuing healthy and lively on disturbance. Another pupa-case (much faded but apparently also of *P. Napi*), was quite full of healthy Ichneumonideous larvæ, motionless at first, but, like the other larvæ, shortly recovering power of movement.

In the case of Cynipideous larvæ of various species I found inquilines of *Cynips Kollari* generally alive and well; the larva of *C. Kollari* itself was of course only to be met with exceptionally, and I noticed in one specimen (and in a very slight degree in some of the inquilines) that the grubs were not as fat and firm as in their autumn state; the segments near the head especially looking as if their contents had been absorbed, and flaccid and impracticable to touch. The larvæ of the *Quercus cerris* (acorn-gall) appeared well, and were of particular interest from this being the second winter they have passed in the larval state. I found the specimens beneath one of the Lucombe oaks at Kew in the autumn of 1877, and they

appear to be of the *Andricus glandium* of Giraud; but at present, from this singular duration of the larval condition (which is mentioned by Dr. Gustav Mayr in the case of his own larval specimens), we have not secured the imago as an English species.

I also found a scale insect of *Aspidiotus conchiformis* on apple bark, with its large eggs apparently perfectly uninjured; a very few specimens of *Thrips*, alive and uninjured; and also specimens of a few other insects in various stages, but not in sufficient numbers to be noteworthy. The *Acari* appeared to be even less susceptible to cold than the insect larvæ.

On the 24th of January (when the highest temperatures had been below thirty-two degrees for some days and the minima at night ranging between eighteen and twenty-seven degrees), I found two species of the bark mite apparently uninjured, the larger ones in very great numbers, and rousing into activity on being brought into the warm room, and the smaller also perfectly recovering. I am not able to differentiate the species with certainty, but they were fully-developed specimens: in the one case with the single claw characteristic of the common *Acarus geniculatus*, and in the other with the claw trifold and heterodactylous.

I also found enormous quantities of the *Calycophthora avellanæ* of Amerling (the *Phytoptus* of the filbert and hazel bud-galls), on the 2nd and 3rd of February, in perfect health, inside the diseased bud growths, and in such great numbers that the masses might even be detected by the naked eye, and amongst them I was fortunate enough to find a good specimen of the egg with the young *Phytoptus*, showing well under a high power, through the transparent pellicle. I much regretted not being able to find more kinds of insects for examination, but (in all I saw) the effects of the cold appeared to pass away on the insect (in whatever stage) being thawed, leaving it, as far as appeared, in its ordinary condition.